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value of £115,246 were imported. This does not include magazines, newspapers, and books sent by post. There are 172 newspapers published in the colony, — 49 daily and 91 weekly, bi-weekly, and tri-weekly, — or 1 to every 3,281 inhabitants. In England and Wales the ratio of newspapers to population is 1 to 13,828; in Ireland, 1 to 32,585; in Scotland, 1 to 21,013; and in the United States, 1 to 4,656.

New Zealand now enjoys direct steam-communication with England by two lines, and there is a fine mail-service running monthly to San Francisco. In 1884 the number of ships entered inwards was 852 vessels of 529,188 tons: of these, the United States was represented by 23 vessels of 10,935 tons. The shipping outwards was 872 vessels of 534,242 tons; of these, 9 vessels of 4,086 tons belonged to the United States. The value of the exports was 7,091,667 pounds sterling, and that of the imports 7,663,888 pounds sterling.

The mining interests will probably increase as new capital flows in to enable the fields — other than the shallow alluvial deposits — to be worked. The value of the gold product since the opening of the mines has been £42,368,192; the amount exported in 1884 was £988,953. The fall in copper has had an injurious effect upon the copper-mines, and their production has been very large. The main development of the past twenty years in mining has been the production of coal. In almost every province of the colony are to be found extensive brown coal deposits. In 1884 the number of tons produced was 480,831. There is a strong probability that early attention will be paid to silver, shale, tin, and the other mineral developments of the colony.

In 1864 New Zealand exported 16,691,666 pounds of wool: in 1884 this had increased to 81,139,018 pounds. In the same time the number of sheep had increased from 4,937,273 to 14,056,266; the number of cattle, from 249,760 to 700,000; of horses, from 49,409 to 170,000; of pigs, from 61,276 to over 200,000. In connection both with pastoral and agricultural pursuits, there has grown up the exporting of frozen meats, and this has encouraged the rearing of sheep on lands formerly used for grain-raising.

The area of land alienated from the crown was, in 1864, only 7,759,954 acres: in 1884 it amounted to 17,692,511 acres. In 1884 no fewer than 6,391,075 acres were under crop and sown grasses. In 1864, as was stated above, New Zealand not only exported almost no agricultural products, but drew its food-supplies largely from abroad. But in 1884 the exports included, wheat, 2,706,775 bushels, valued at £436,728; barley, 128,450 bushels, worth £25,138; malt, 51,311 bushels, worth £14,-

665; and oats, 2,474,613 bushels, worth £267,286. The exports also included £33,324 worth of flour, £53,536 worth of potatoes, and 254,069 hundred-weight of frozen meat, valued at £345,090.

Agriculture is now seeking other outlets: orchards are being planted, tobacco is raised, and linseed is now produced. The area of forest-lands is 20,000,000 acres, and of this area 9,000,000 acres contain useful timber-trees.

The manufacturing establishments are of so recent a date that statistics have not been obtained concerning them; but during this year it is proposed to determine accurately their number, the amount and value of the goods produced, and the number of workmen employed. For manufacturing purposes, New Zealand has the unusual advantages of a moderate climate, a large coal-deposit, and ample water-supply in almost any part of the colony.

The wealth and material prosperity of the colony are rapidly increasing. In 1881 there were, in all, 103,335 houses, of which 87,646 were wooden. In 1884 the savings banks had on deposit £1,926,005, and the ordinary banks £9,372,004. One person in every seven holds a life-assurance policy, — a larger percentage, probably, than obtains in any other country. The value of the personal property that is taxed is 40,000,000 pounds sterling, and the value of the real property held by the colonists is 75,000,000 pounds sterling. 1,527 miles of railway are in operation, and 10,474 miles of telegraph-wires; and 1,961 telephones are in use. The number of letters carried in 1884 was 16,611,959, and the number of telegrams sent 1,654,305. Gas is used in 27 incorporated towns. The colony's revenue in 1884 was £3,955,188, and its expenditure £4,101,318. The large expenditure was due to the fact that large sums were borrowed for the prosecution of public works. The total public debt is £30,649,099, but of this a large proportion has been spent on public works which are now returning a good interest.

Sir Robert Stout predicts that this splendid progress will be maintained, and that population will rapidly increase. Agriculture will become more varied and be diligently prosecuted, dairy farming will come into prominence, and mining will increase. He thinks, too, that the record of the next twenty years will show an advance rather greater than less than that which his valuable paper describes.

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#### DISTRIBUTION OF POWER BY COMPRESSED AIR.

AIR at a pressure of forty-five pounds to the square inch will, in the near future, displace steam as a motive power in many of the smaller manu-

facturing establishments of Birmingham, England. The air will be compressed at a central station, and supplied through street mains, much as gas and water are now distributed, taking the place of steam for driving engines. Steam has long been distributed from a central station in this city with economy and safety, and there is no reason why compressed air should not be distributed in a similar manner. The Birmingham company, which has charged itself with this enterprise, will begin operations with a plant capable of supplying fifteen thousand horse-power, six thousand of

single-acting air-compressors, capable together of delivering two thousand cubic feet of air per minute at forty-five pounds pressure, will be driven by each engine, making a total capacity of thirty thousand cubic feet per minute. Six million gallons of water per day will be required for the boilers and condensers.

The street mains will be of wrought iron, laid in concrete troughs with removable covers, not far below the surface of the street. Valves will be fixed at intervals in the mains, to automatically shut off the air in case a section of pipe



POWER DISTRIBUTION BY COMPRESSED AIR, IN BIRMINGHAM, ENGLAND.

which have already been contracted for. The accompanying illustration shows the district covered by the first plant, the darker portion being that which will be first supplied with power. This area will require about twenty-three miles of mains, ranging in diameter from seven inches up to twenty-four. The central station is located between a railroad and a canal, so that coal and water are readily obtainable. The coal will be converted into gas, which will be then used as fuel under the boilers, of which there will be forty-five, supplying steam to fifteen triple expansion engines of one thousand horse-power each. Six

should burst; the same valves serving as stop-valves, which can be closed by hand, if desired, through man-holes in the street. The compressed air delivered to customers will be measured by meters, and charged for by the thousand cubic feet, a special device in the meter compensating for any variations in pressure. The total amount used will be registered on a dial at the central station by electric apparatus.

A paper upon the Birmingham compressed air scheme was read before the British association on Sept. 8 by Mr. J. Sturgeon, in which he showed that the large number of engines of moderate

size used in Birmingham, often intermittently, renders the system peculiarly applicable to that city. Although each thousand horse-power at the central station may produce only five hundred horse-power at the users' engines, it will displace fully a thousand horse-power of small boiler plant, etc., while the centralization of the power-producing plant admits of the conversion of fuel into power under conditions most favorable to economy and efficiency.

### THE MENTAL FACULTIES AND SOCIAL INSTINCTS OF APES.

A WRITER in the *Revue scientifique* (Aug. 28, 1886) has made an admirable *résumé* of the suggestive analogies between the mental habits of the higher quadrumana and those of low savage tribes, and to some extent of civilized children. The importance of this stage in mental evolution has not been overlooked; but much of the material is unreliable, and direct observations by good observers are few. Mme. Clémence Royer gives copious references to the best of these observers, and thus succeeds in making a useful presentation of the subject in a very few pages. Even the mere summary which is here to follow, of the points in common to the ape and the savage man, will be sufficient to impress one with the far-reaching extent and real significance of this comparison.

*Sociability and the family.* — The degree of sociability varies greatly in different species. The gorillas of West Africa live in small patriarchal families, while the cynocephalus and many American species live in troupes, without any definite sexual relations. Savage tribes showing each of these forms of family life have been described. Houzeau remarks that the patriarchal system is maintained among many of the anthropoid apes by subordination to the authority of a chief. Each group has but one chief, — an adult male. The females and young ones are subject to his control until they tire of this dependence, and abandon or kill the ruler. Among the chimpanzees and gorillas, even smaller families, with a single pair at the head, are found; and here the feelings of maternal and conjugal love are developed to a high degree. Paternal affection is rare, but many savages do not recognize the right of the father. It is common to find them tracing descent through the female line only, without any regard to paternal instincts. Three authenticated examples of conjugal love among apes are recorded.

*Language.* — By this term must be understood, not a finished systematized speech, but simply some rudimentary mode of expressing emotional

and mental states by sounds and gestures. Apes, of course, have cries for all their common emotions, — their desires, their fears, pains and pleasures. These cries differ considerably in different species. Houzeau records an instance in which the animal used a special cry when it was displeased by having an object given to it which was not the one it wanted.

The faculty for imitation is certainly characteristic of the quadrumana, and has given us the phrase 'to ape.' It is a trait common to savages, to children, and to idiots; in short, to low-type, undeveloped minds. The attitudes and general conduct of apes are so human, that some savages believe that it is only out of spitefulness that they do not speak. But even this poverty of sounds is not without parallel in savages: many have a very meagre alphabet of sounds, and help themselves out with clicks and natural noises. All apes (except, perhaps, the orang-outang) have voice: they often repeat sounds, which are usually complex articulations involving gutturals and harsh sounds, with little variation. But the New-Zealanders lack twelve of our consonants, and other tribes show similar imperfections. And, curiously, it is just the labials so often found absent in the languages of the lowest species of men that are never used by apes. But the labial *m* is almost the first sound learned by the civilized chief, as is shown in the word 'mamma.'

Apes readily understand our language sufficiently to be tamed, and trained to astonishing performances; and they are guided by sound as well as by gesture. Perhaps they understand our language somewhat as a child of fifteen or eighteen months understands its mother. But of course they lack every trace of a method of recording mental conditions. If the most primitive savage had not had some sort of record-making, even so simple as the Peruvian *quipus*, we could hardly know of his existence.

The phrase of Rabelais, that 'laughing is a peculiarity of the genus Homo,' is shown false by the evidence of this power in apes. It may be noted that many half-civilized people laugh very seldom, such as the Turks. One can readily read the expression on an ape's countenance. They weep too, and have been observed to frown.

*Fêtes and funeral rites.* — Houzeau likens the assemblages observed among the quadrumana to those of the Hottentots and other people. The apes of South America, when they have drained the resources of a certain area, have a re-union before they decide to emigrate. They jump and run and shout; the males running along the trees, while the females carry the young ones in their arms. Stories are told of the regularity